Staff Workshop on the California Energy Commission's Public Interest Energy Research (PIER) Renewables Research Roadmaps

PIER Renewables Program: Roadmap Updates

June 3, 2008

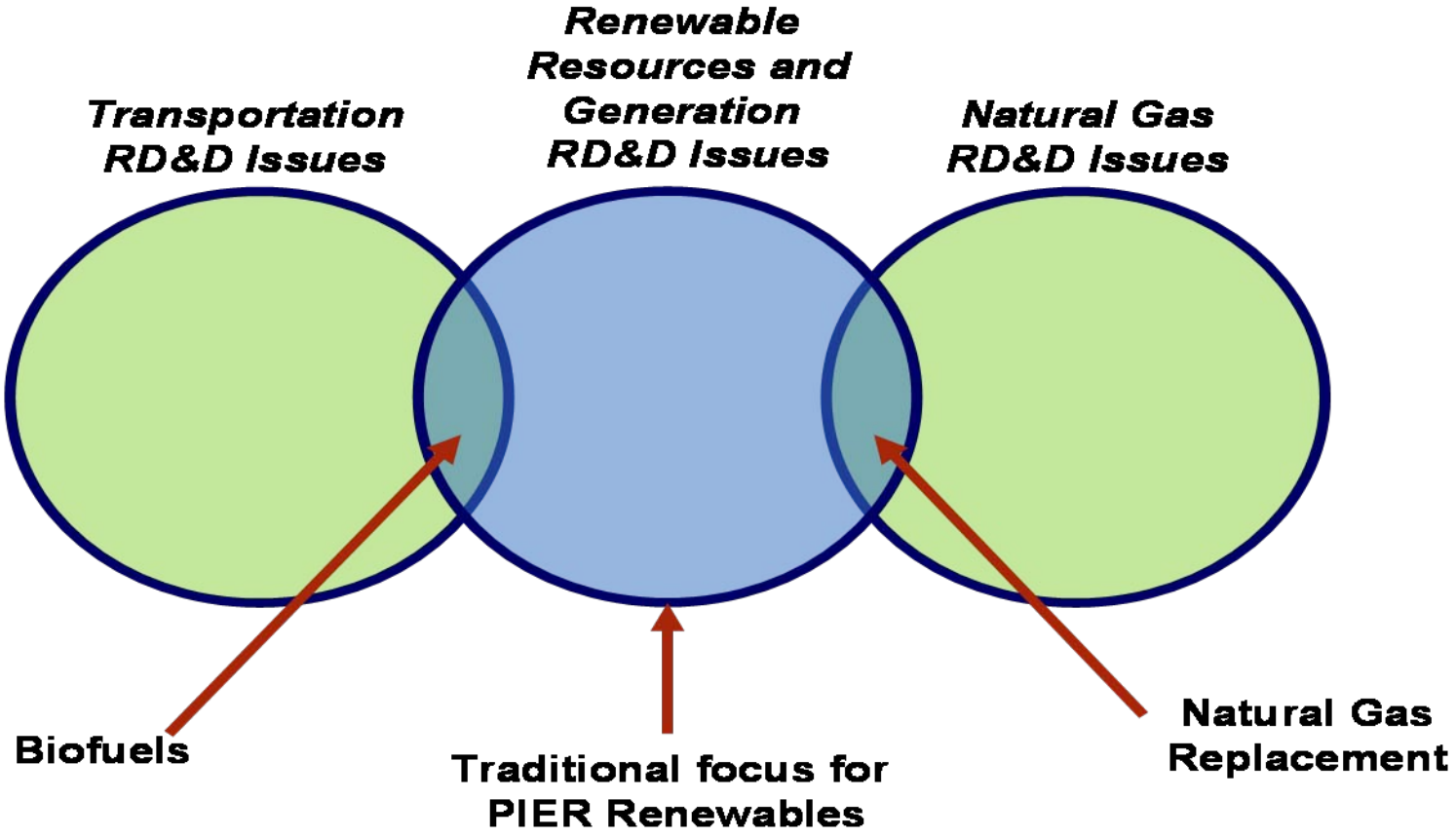
PIER Vision

"The mission of the Public Interest Energy Research Program is to conduct public interest energy research that seeks to improve the quality of life for California citizens by providing environmentally sound, safe, reliable and affordable energy services and products. Public Interest Energy Research includes the full range of research, development, and demonstration activities that will advance science or technology not adequately provided by competitive and regulated markets."

The vision developed by PIER Renewables for the Roadmap is:

"*Renewable energy resources will provide at least 33% of the electricity by 2020 for the California energy system, providing consumers and energy providers with affordable, reliable, secure, and diverse clean energy services.*"

Biomass: Unique RD&D Focus



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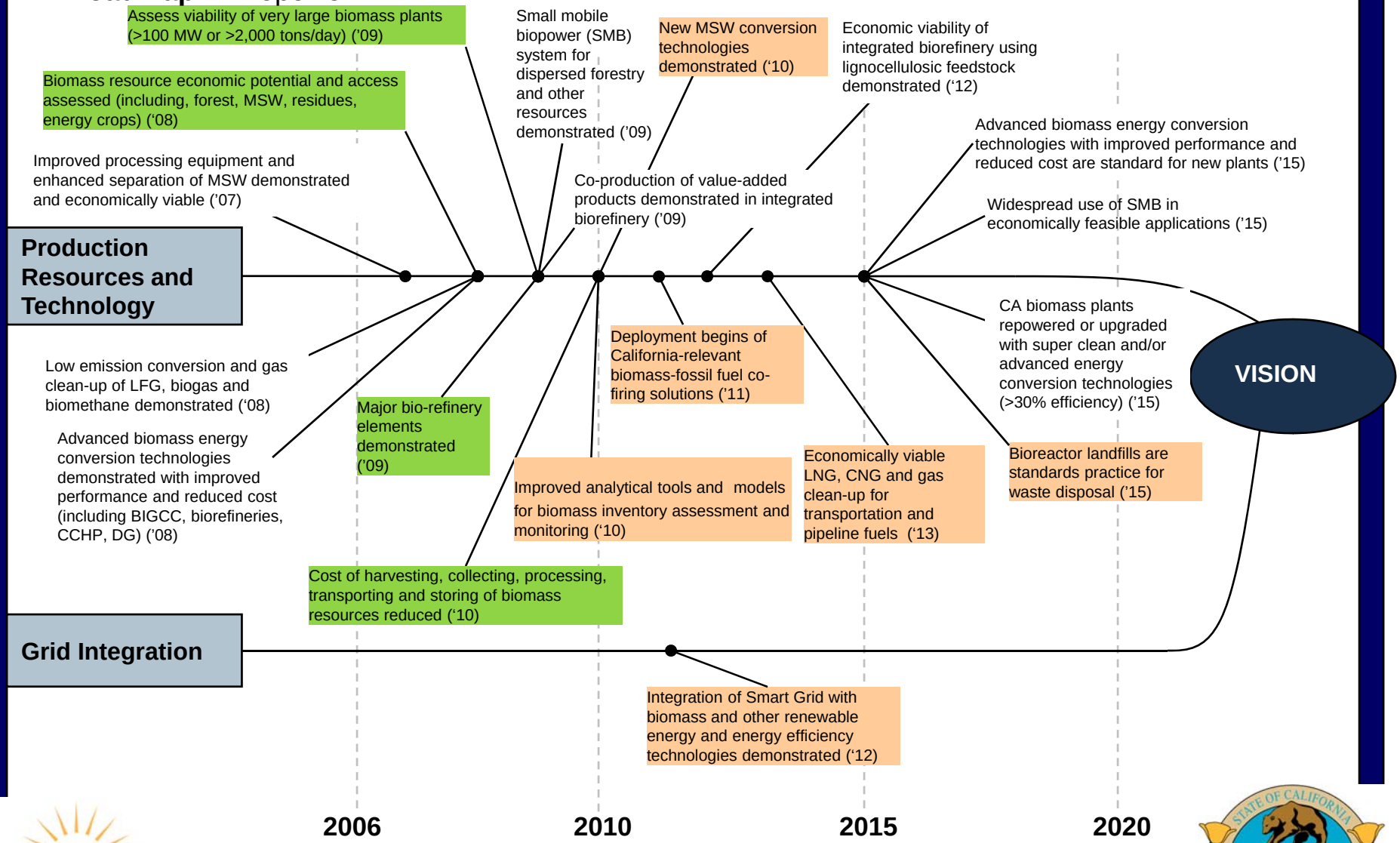
Roadmap Biopower



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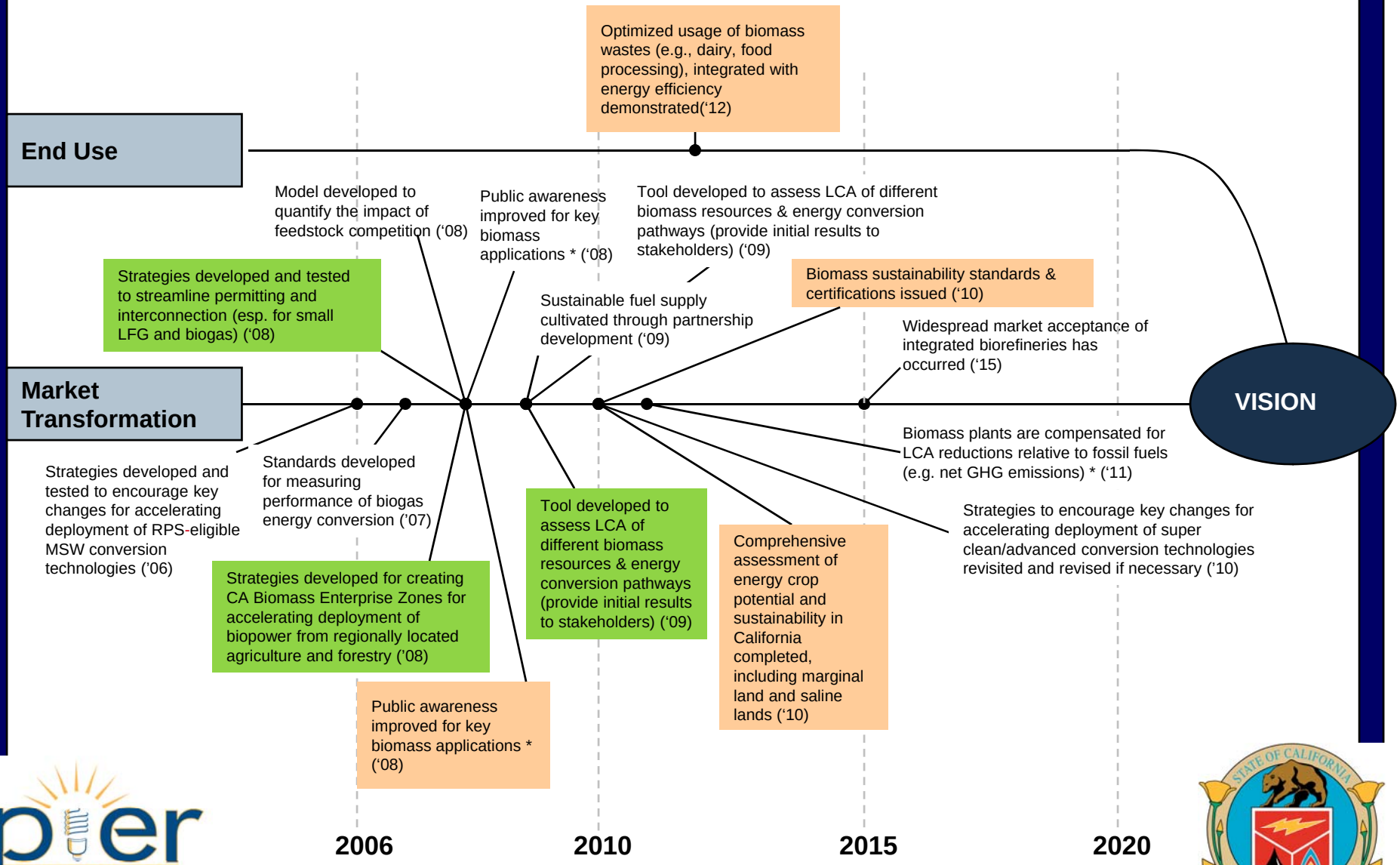
"Research Powers the Future"

Roadmap Biopower



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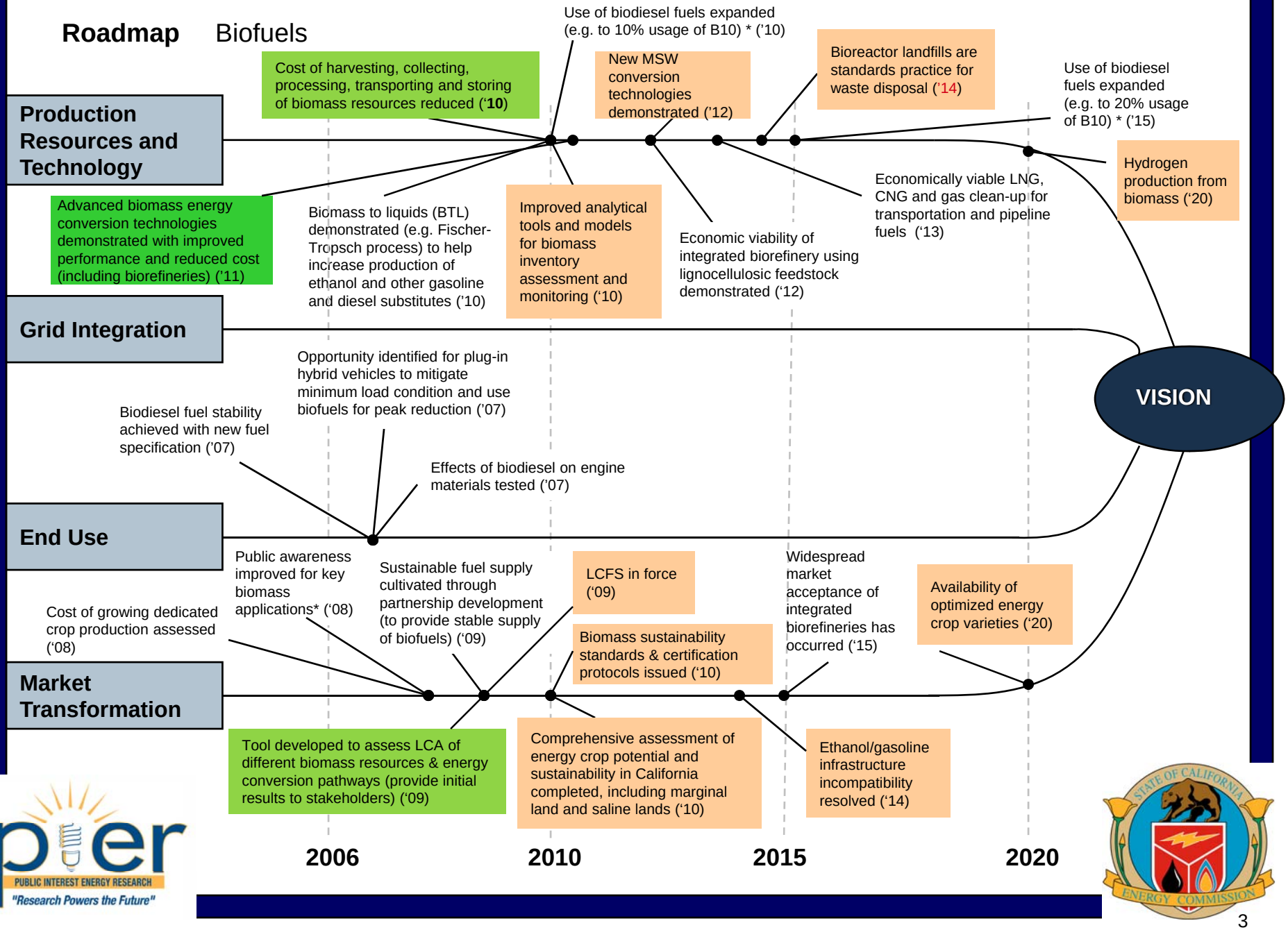

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Biomass RD&D Update: Status & Accomplishments

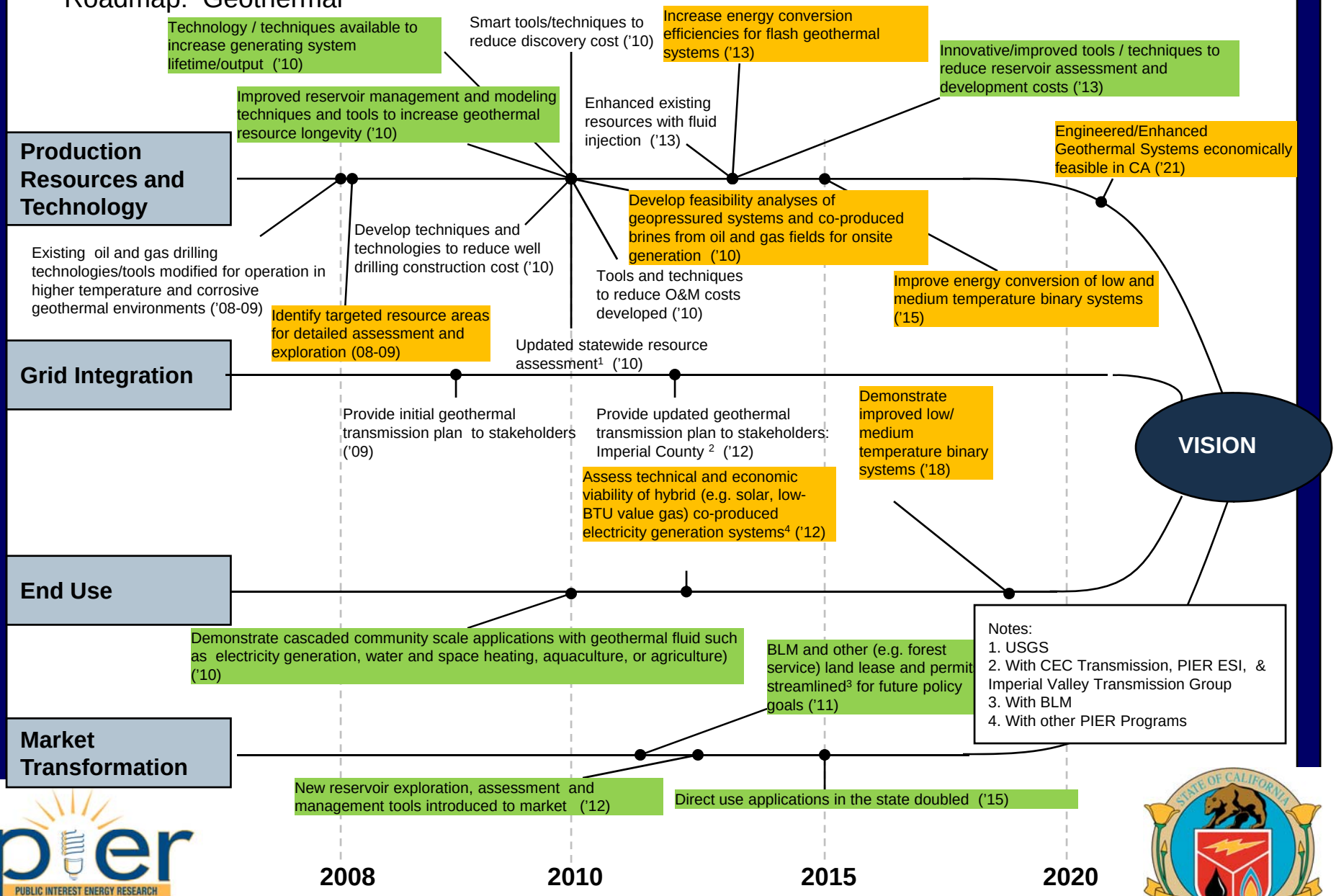
- **Production Resources and Technology**
  - Biogas Solicitation: Received 17 proposals (Reviewed & scored 15 and awarded 5). Completed demonstration of 5 low emission conversion technologies (e.g., Makel (HCCI), TIAX (biohalo), SCS (microturbine), Valley Fig (microturbine), FlexEnergy (microturbine)) using landfill gas and food processing wastes.
  - Biofuel Solicitation: Received 19 proposals (Reviewed & scored 18 and awarded 3). Bluefire Ethanol declined the award. Executed 2 funding agreements with REII & SFPUC.
  - Natural Gas Replacement Solicitation: Received 24 proposal (Reviewed and scored 24 and awarded 4). Prepared 4 funding agreements for grant awards with GTI, LBNL, Diversified Energy Corp, and SMUD
  - Biopower Solicitation: Received 5 proposals (Reviewed & scored 5 and awarded 2). Executed 2 funding agreements with Growpro Inc. & UC San Diego.
  - Dairy Power Production Program: Funded 18 systems.To-date 11 systems are now generating 3.3 MW total.
  - Programmatic Solicitation: Awarded & completed 3 programmatic projects with Hetch Hetchy/SFPUC, Commonwealth Energy & SMUD. Final reports for biomass & other projects are in the publication process.
- **Grid Integration**
  - Strategic Value Analysis
    - Linking cost competitive biomass resources to electricity system needs while addressing public benefits
- **Market Transformation**

  -California Biomass Collaborative Support
    - Biomass Roadmap for Biomass Development
    - Updated Biomass Resource Assessments
    - Updated Biomass Performance Reporting System
    - Fourth & Fifth Biomass Forum
    - Offered Biomass Short Courses
    - Biomass Information Clearinghouse
    - Technical Support to Bioenergy Interagency Working Group (BIWG)
  - Policy Support
    - BIWG Executive Order S-06-06, Bioenergy Action Plan, IEPR, Low Carbon Fuels Standard

-Collaborated with other state agencies on their solicitations & AB 32 scoping plan projects (e.g., CARB, CIWMB, CDFFP, CDFA)

-Collaborated with USDOE – reviewed proposals

Roadmap: Geothermal



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Geothermal: Update & Outlook

PRODUCTION RESOURCES AND TECHNOLOGY:

- ***Exploration: Drilling:*** Since 2005, drilled new cost-shared wells in four fields.
- ***Exploration: Geophysics/Remote Sensing***: Magnetotelluric surveys; thermal infrared imaging (ASTER TIR)
- ***Innovative approaches/new applications:*** First successful, commercial near horizontal geothermal well; Fluid inclusion chemistry: inexpensive, fast technique to identify potential producing geothermal zones.
- ***Reservoir /Plant Management:*** Reservoir structure from passive seismic measurements; Field wide fluid injection strategies modeling; Integrated Geothermal System Simulator for coordinating production-injection and power plant operating parameters; silica recovery and evaporative cooling.
- ***Environmental Mitigation:*** Microseismicity; remote sensing (InSAR) of surface terrain changes; mercury mitigation

END USE:

- ***Direct Uses:*** Canby (Modoc County), district heat system; Weaverville: Ground source heat pump system .

MARKET TRANSFORMATION:

- ***Stakeholder interaction and research planning efforts*** (CGEC, GRC; Direct Use Network)
- ***Statewide resource assessment database*** (GeothermEx, 2004)

New projects $5.7 MILLION FUNDED FROM 2007 SOLICITATION

GEOTHERMAL PRODUCTION RESOURCES AND TECHNOLOGY

- Development and Demonstration of Improved Steam Scrubbing Technology for Increasing Effective Steam Quality at Wellheads and Power Plants (The Geysers)
- CFEX Self-Expanding Tubulars, (Salton Sea)
- Exploration and Assessment of the San Felipe- Truckhaven Geothermal Area (Imperial Co.)
- Reservoir Confirmation of the Buckeye Power Plant Area, Wildhorse State 36 Confirmation Well Northwest Geysers, Sonoma Co. (The Geysers)

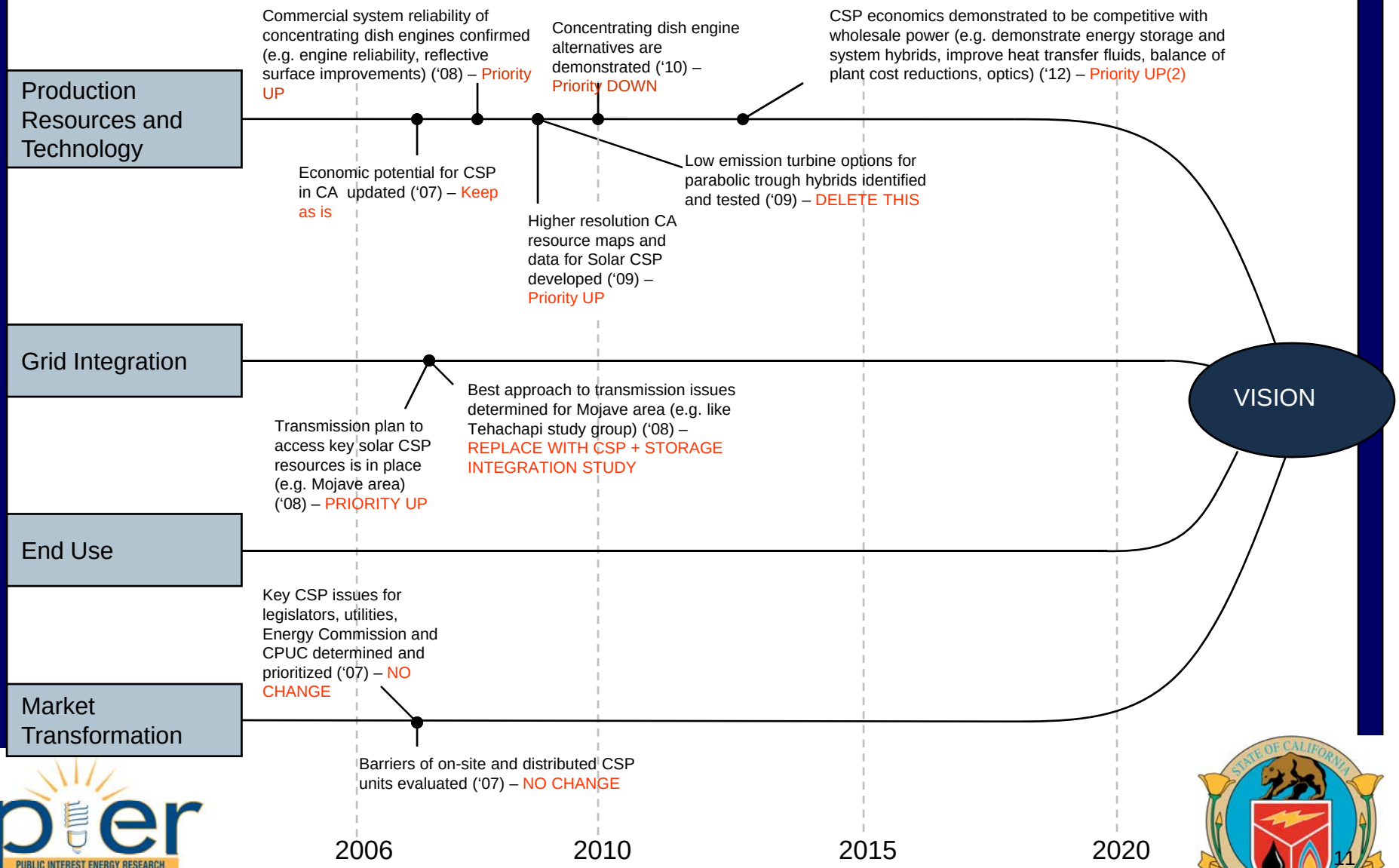
END USE

- Canby Geothermal Development (Modoc County)
- Geothermal Well Testing/ Assessment (Fort Bidwell)

MARKET TRANSFORMATION

- Addition by Subtraction: A Roadmap to Improving Adoption of Geothermal Heat Pumps in CA

Solar CSP Milestones



Additional CSP Milestones

Production Resources and Technology:

Storage, Cooling, Material, and Operational Tool development

- Demonstrate feasibility of thermal storage
- Conduct a study on hybrid (dry/wet) cooling
- Conduct a study on glass coating and IR emissivity
- Conduct a study on heat transfer fluid for high temp. and lower freezing point
- Test a prototype of heat transfer fluid and control system for CSP storage

Grid Integration:

- Conduct CSP/storage/transmission/grid integration feasibility studies leading to demonstrations
- Identify & address technical and business issues of CSP and wind Integration
- Develop tools for CalISO & utilities to operate integrated CSP & wind projects.
- Identify & address operating Issues of CSP: e.g. reliability, dispatchability, etc.

Additional CSP Milestones (Contd.)

End Use:
• Develop high resolution solar resource data (1 x 1 mile sq and hourly)

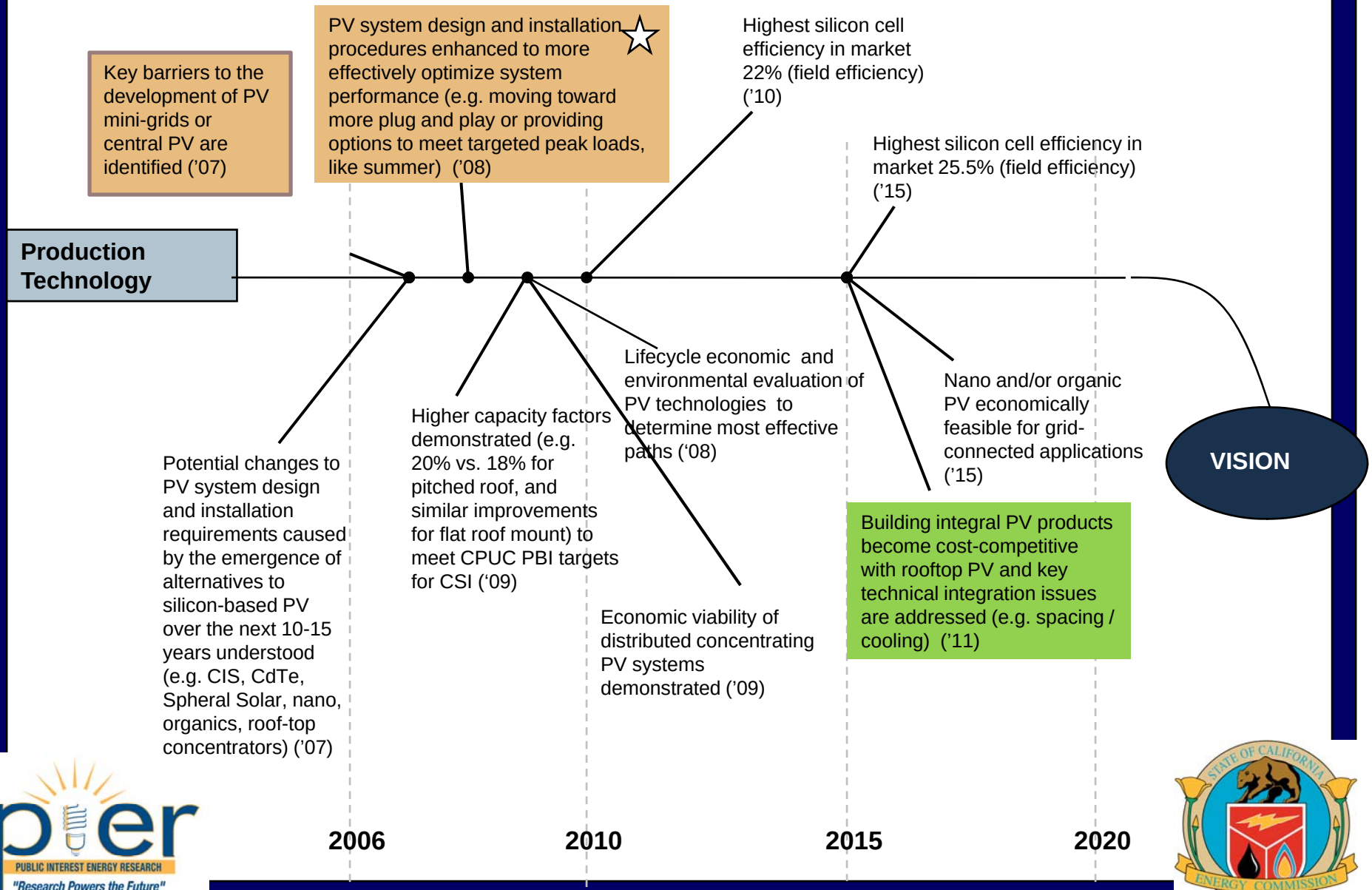
Market Transformation:
• Conduct a study to demonstrate the full value of CSP with storage (from utility perspective) • Develop a CSP Interagency Action Plan • Reinvest Natural Gas retirement credits into co-located CSP plants • Conduct a study on converting Mohave area into CSP projects • Study the feasibility and benefits of smaller, distributed CSP plants (<50 MW)

RD&D Update: Status & Accomplishments

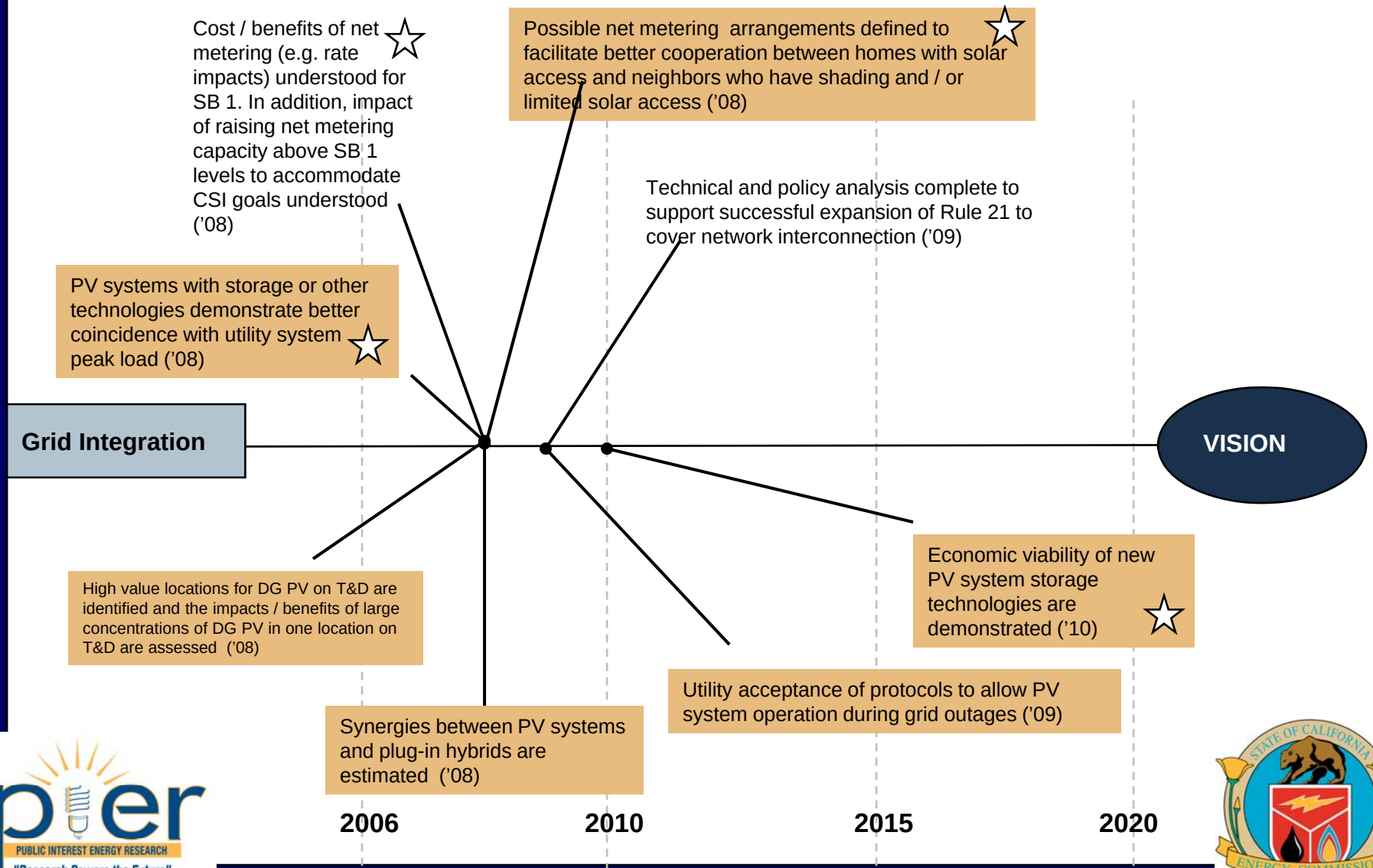
Funded a major study of Parabolic Trough technology:

- Contractor : Solargenix (a subsidiary of Acciona, Spain)
- **Major Goals**:
  - Conduct CSP resource assessment
  - Develop innovative power purchase agreements for CSP
- **Accomplishment**:
  - Developed PPA models and CSP resource assessment for SW states
  - PPA helped secure contract with Nevada Power Co. and Sierra Pacific Power that led to the construction of the largest CSP plant in the world (64 MW) in Boulder City, Nevada in 2007. Also built a 1 MW CSP plant (Seguaro Power Plant) for Arizona Power System in Phoenix, AZ.

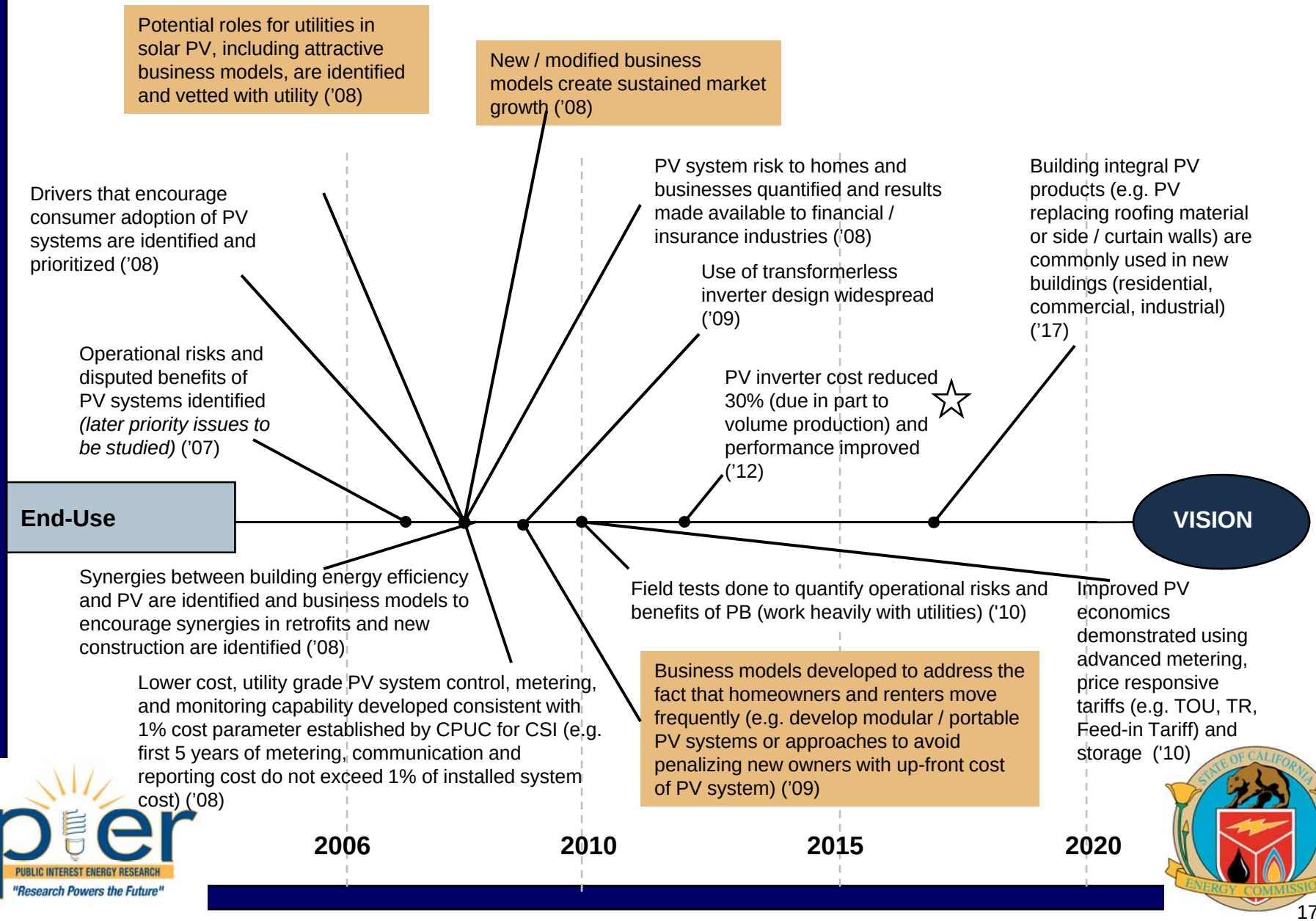
PV RD&D Roadmap Platform 1: Production Technology



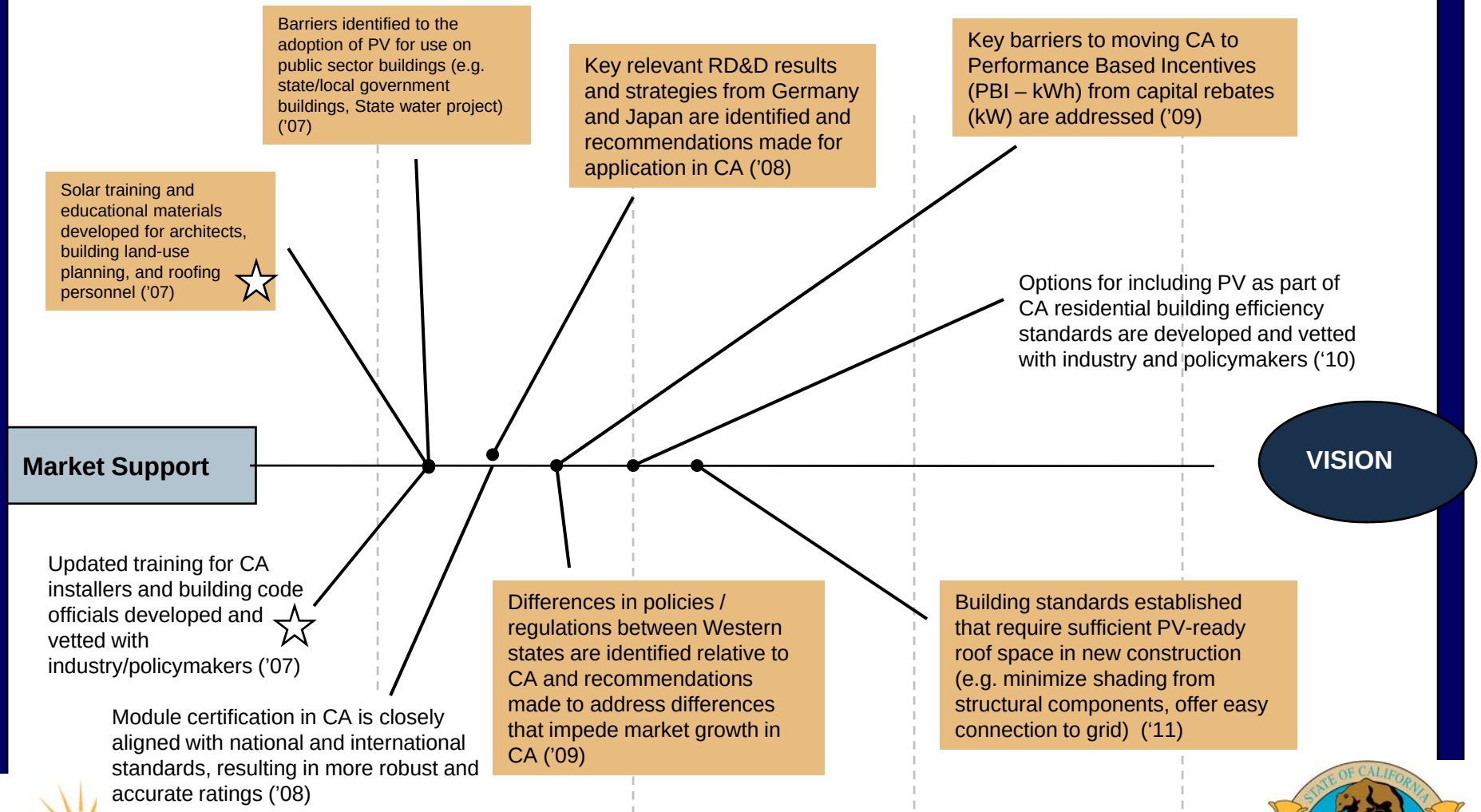
PV RD&D Roadmap Platform 2: Grid Integration



PV RD&D Roadmap Platform 3: End Use



PV RD&D Roadmap Platform 4: Market Transformation



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PV RD&D OPPORTUNITY AREAS:

Area 1. Plug and Play Innovation:
Developing value-added components, sub-systems or packaged systems that reduce installed cost through standardization and/or simplification of design and installation

Area 2. High Value Systems and Energy Storage:
Demonstrating value enhancement and cost competitiveness of PV systems through high value applications, such as: integration of PV with advanced metering and storage to achieve better coincidence with peak load

Area 3. Grid Integration:
Developing alternatives to current grid integration standards, procedures, and policies, and establishing the impacts of higher net-metering cap, alternate rate structures, and high penetration of distributed PV on the grid.

Area 4. Innovative Commercial Offers:
Evaluating and developing innovative business models and financing mechanisms to accelerate market uptake and support sustainable growth of PV.

Applicant	Project Title	PIER Funds Recommended
GreenVolts	Low Cost Installation of Concentrating PV	$250,000
SolarTech (SV Leadership Group)	Enabling Photovoltaic Markets in California Through Building-Integration, Standardization and Metering in the Carbon Economy	$747,253
Tilt Solar	Demonstration of a Novel Low-Cost Two-Axis Solar Tracking System	$246,816
GreenRay	Development of an AC Module System	$250,000
Gaia Power Technologies	Modular Turnkey Energy Storage Systems for Integration with Photovoltaics	$247,816
UC Merced	Development and Demonstration of a Concentrating PV System for Commercial Applications	$258,115

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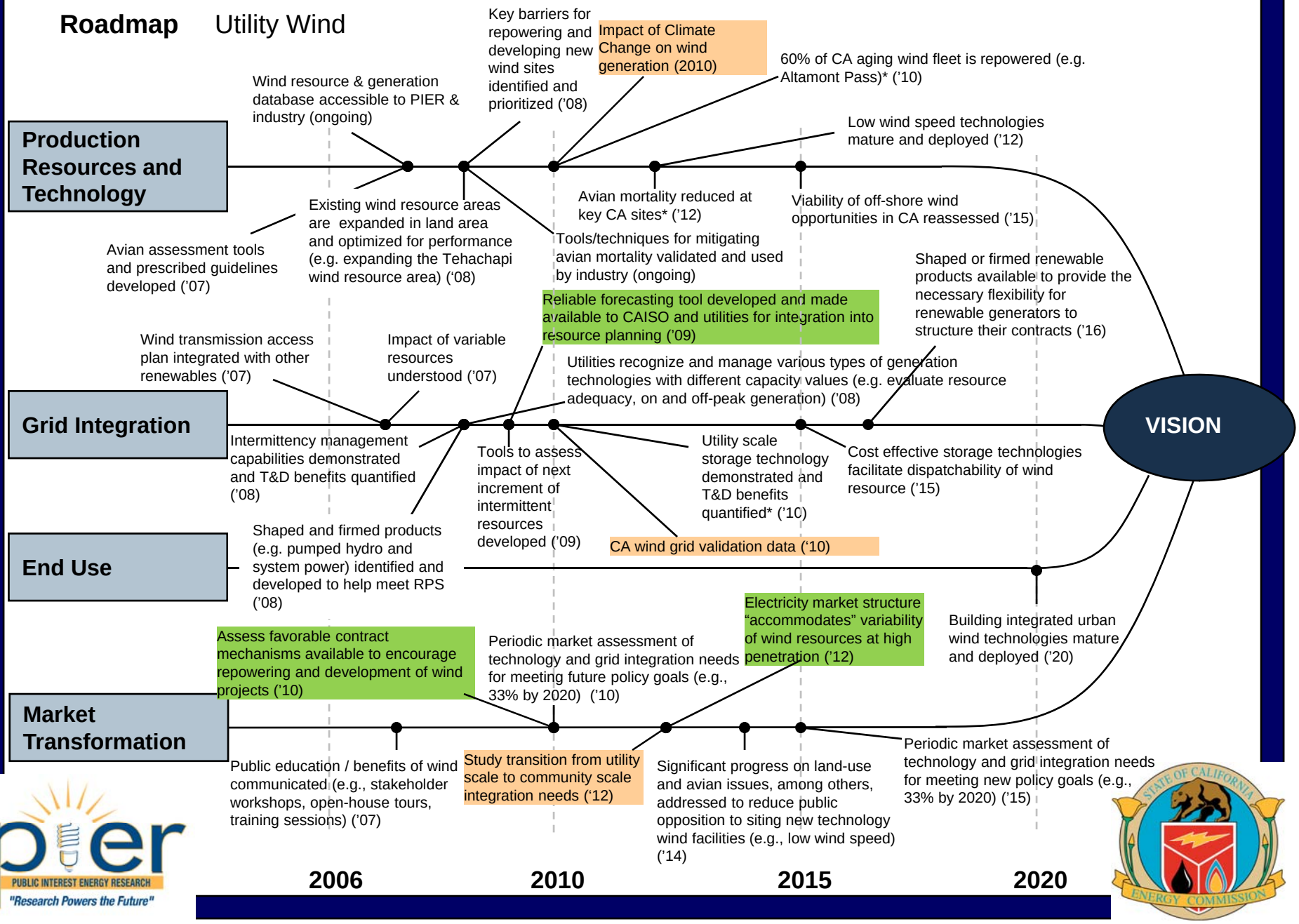
Roadmap Utility Wind



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Update: Wind

- Production Resources and Technology
  - Improvements to modeled wind maps at 4 areas (Mojave, San Gorgonio, Antelope Valley, Mayacamas Mtns)
  - Sodar and tall tower measurements, publicly available data
  - Wind demo portal
  - Wind resource profiles for new sites
  - Boundary layer research to improve modeling efforts
- Grid Integration
  - CA specific wind facility and transmission characteristics
  - Wind-Storage-Enhanced Transmission R&D Solicitation, 2 projects
- End-Use
  - CWEC outreach and technical training activities (technician & small wind systems)
  - FAA obstruction lighting research
  - Summary of setback and permitting requirements
- Market Transformation
  - Past, present & future report to give the facts on wind turbine technology trends and grid-friendly improvements
  - Stakeholder interaction (utilities, WGA, AWEA, PowerGen)
  - Wind research planning efforts (CWEC, utilities, industry)